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(54) WASTEWATER CLARIFIER

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(57) Claim The claim defining the invention is as follows: A clarifier for removal of suspended matter in a liquid characterised in that said liquid is caused to pass from bottom to top through an enclosure (1) of open gravity or pressure vessel design comprising a base, an upper internal screen (2) located at a distance from the top of the tank to allow clarified water to be collected and discharged, a second internal screen (3) located at a distance from the base, granular media (4) with a density of less than 1.0 g/cc located between the two internal screens, a water inlet (5) located towards the tank base and below the lower screen (3), a water outlet (7) located above the upper screen (2), a wastewater outlet valve (10) located near the tank bottom between the tank base and the lower screen (3), an air distribution network (8) located above the tank base and below the lower screen (3), in that during normal operation of the clarifier, the raw water with the required amount of flocculant enters into the clarifier at the base and passes through the granular column before it is discharged out of the clarifier by outlet pipe (7), and in that during cleaning operation of the clarifier, the raw water inlet flow is stopped, and the wastewater outlet valve is opened with air being passed into the bottom of

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(11) AU-B-67438/87

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the tank, the granular media thereby caused to immediately expand thus releasing the entrapped floc and at the same time dirty water is drained out of the tank by opening of the wastewater outlet valve (10).

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PATENTS ACT 1952

## PETTY PATENT SPECIFICATION

(ORIGINAL)

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1. This form is used to describe the invention in full, and the best method of performing it known to the applicant.
  2. The description is to be typed on as many sheets of good quality A4 International size paper as is necessary and inserted inside this form.
  3. A single claim defining the invention must start on a new page. If there is insufficient space on this form for the claim, use separate sheets of paper beginning with the words "The claim defining the invention is as follows" and ending with the date and the name of the applicant in block letters.
  4. This form must be accompanied by (a) a true and exact copy of the description, claim and drawings (if any), and (b) an additional copy of the claim.
- (see formal requirements in the Guide for Applicants for Patents)

## TO BE COMPLETED BY APPLICANT

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Petty Patent Specification for the invention entitled:

"IMPROVEMENTS IN WATER TREATMENT PLANT CLARIFIERS"

The following statement is a full description of this invention, including the best method of performing it known to me:—

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This invention relates to certain "improvements in water treatment plant clarifiers".

10 A typical industrial or town drinking water treatment plant incorporates the processes of chemical flocculation, coagulation, clarification and filtration as well as chlorination. Most suspended and colloidal solids, colour, and some organics are extracted in the insoluble floc formed by the addition of flocculants. The processes of clarification and filtration are used to remove this insoluble floc from the water. The clarifier usually acts as a primary removal device extracting a large percentage of the insoluble floc. The filter acts as a polisher removing less total floc but generally ensuring a good quality treated water.

20 Many designs of clarifiers have been utilised for the primary removal of floc. Their problems include large size and related high cost, difficulty in operation caused by adverse currents, water temperature differentials and other hydraulic phenomena. Sludge extraction techniques vary with clarifier designs, sometimes ineffective and inefficient with respect to volume of waste water.

It is the object of this invention to overcome some of the above problems by an improvement to one specific clarifier already in existence.

According to the invention there is provided a clarifier consisting of a vertical tank with an internal upper screen. The upper screen is located a certain distance from the top of the tank to allow the clarified water to be collected and discharged. The tank can be

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either open gravity design with a bottom and open top or, of a pressure design with enclosed top and bottom.

Below the screen is placed a certain volume of granular media with a density of less than 1.0 g/cc. The volume of media is such that it does not completely fill the space between the bottom of the clarifier and the upper screen.

10 Raw water dosed with the desired amount of flocculant is directed into the clarifier at the base by a nozzle. The flocculated water passes through the column of granular media which, by its density, is held against the top screen. Flocculated matter is removed in passing through the granular column by processes and physical phenomena similar to those of a typical granular filter. The clarified water passes through the upper screen and is directed out of the clarifier by an outlet collection pipe.

20 Cleaning of the media is carried out on a periodic basis by distributing air beneath the media while continuing the raw water inlet flow. The violent bubbling action of the air cleans the grains, breaks up larger floc particles and expands the bed due to the volume of air passing through the media. At the same time, a wastewater outlet valve located above the upper screen opens and directs the dirty water out of the clarifier. After a certain period, the volume of water within the clarifier returns to a relatively low suspended solids concentration and the wastewater outlet valve is closed and air supply turned off. The clarifier is now in the clarification cycle once more.

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So far the construction and operation is similar to a particular clarifier already in existence, and the further details constitute the improvements.

10       The clarifier is to be fitted with a second internal screen located a certain distance from the base and the media is to be placed between these screens. The volume of the media is such that it does not completely fill the space between the upper and lower screens leaving room for expansion during the cleaning cycle. A wastewater outlet valve is located near the bottom of the clarifier between the lower screen and the tank base in lieu of above the upper screen. An air distribution network is located above the base of the clarifier and below the lower screen.

20       The clarification cycle is similar to that described previously. However, the cleaning cycle is different whereby upon initiation of the cleaning cycle, the raw water inlet flow is stopped, the wastewater outlet valve is opened and air passed into the bottom of the clarifier. The granular media bed immediately expands thus releasing the entrapped floc and at the same time dirty water begins to drain to waste via the wastewater outlet valve. After a certain time, all the dirty water has been drained and the clarification cycle recommenced by closing the wastewater outlet and air inlet valves and opening the raw water inlet valve. More effective removal of entrapped floc together with less waste water and reduced cleaning cycle downtime are the benefits of the invention.

A particular embodiment of the invention will now be described with reference to the accompanying drawing Figure 1 on page 5.

The clarifier tank 1 is fitted with an upper screen 2 and a lower screen 3. The floating media 4 is placed between the two screens.

Chemically dosed raw water is directed into the bottom section of the clarifier via the raw water inlet pipe 5. The water is induced to flocculate in section 6 by hydraulic mixing. The water passes upwards through the bottom screen 3, granular media 4 and top screen 2, being finally collected in the clarified water outlet pipe 7. Most of the floc particles are trapped in the media column 4.

Cleaning of the clarifier is accomplished by simultaneously passing air into the bottom air distribution pipe by opening air inlet valve 11, closing the raw water inlet valve 9 and opening the wastewater outlet valve 10. Dirty water is then passed to drain and after a certain period valves 10 and 11 are closed and valve 9 opened to restart the clarification process.

The claim defining the invention is as follows:

A clarifier for removal of suspended matter in a liquid characterised in that said liquid is caused to pass from bottom to top through an enclosure (1) of open gravity or pressure vessel design comprising a base, an upper internal screen (2) located at a distance from the top of the tank to allow clarified water to be collected and discharged, a second internal screen (3) located at a distance from the base, granular media (4) with a density of less than 1.0 g/cc located between the two internal screens, a water inlet (5) located towards the tank base and below the lower screen (3), a water outlet (7) located above the upper screen (2), a wastewater outlet valve (10) located near the tank bottom between the tank base and the lower screen (3), an air distribution network (9) located above the tank base and below the lower screen (3), in that during normal operation of the clarifier, the raw water with the required amount of flocculant enters into the clarifier at the base and passes through the granular column before it is discharged out of the clarifier by outlet pipe (7), and in that during cleaning operation of the clarifier, the raw water inlet flow is stopped, and the wastewater outlet valve is opened with air being passed into the bottom of the tank, the granular media thereby caused to immediately expand thus releasing the entrapped floc and at the same time dirty water is drained out of the tank by opening of the wastewater outlet valve (10).

Dated this 25th day of February 1987



*Robert McDonald*

Robert McDonald

Applicant

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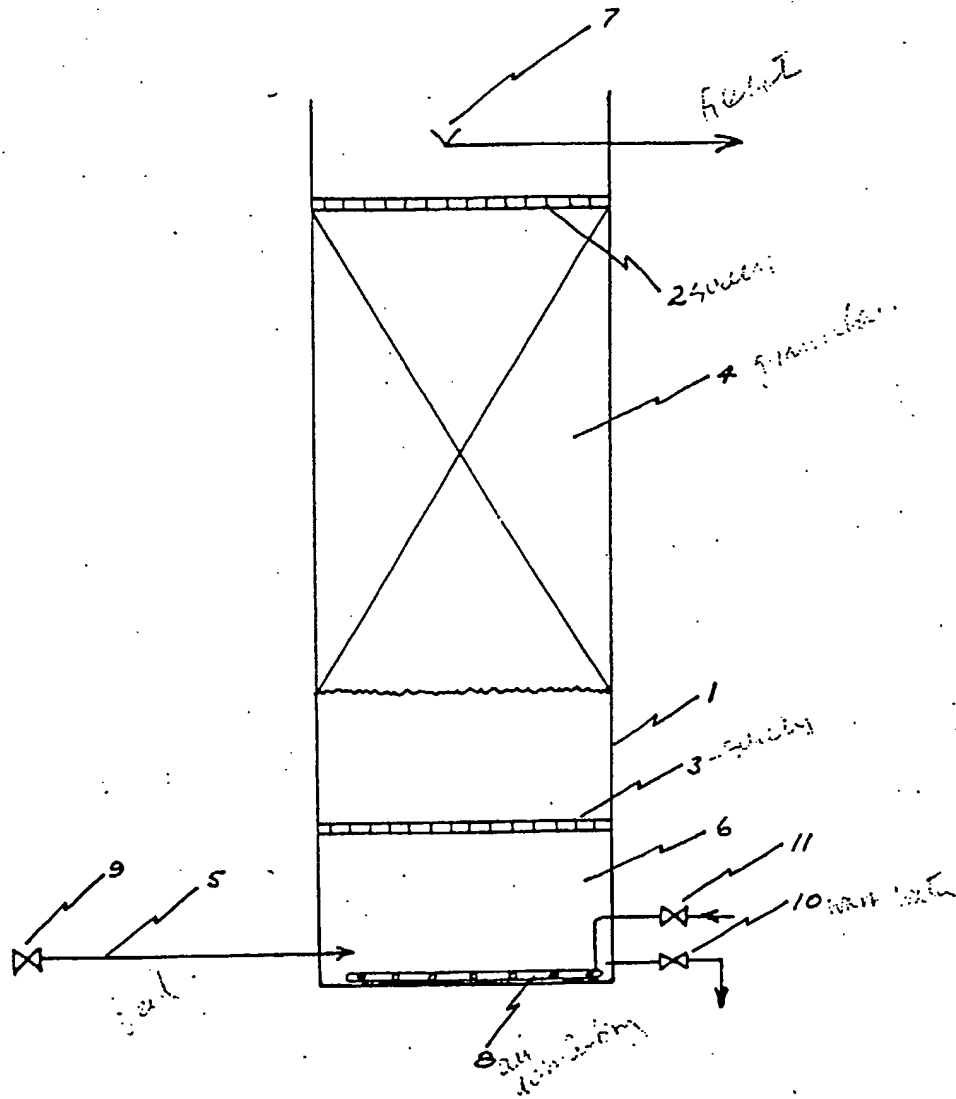


FIGURE 1.

CROSS SECTIONAL VIEW OF CLARIFIER

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